

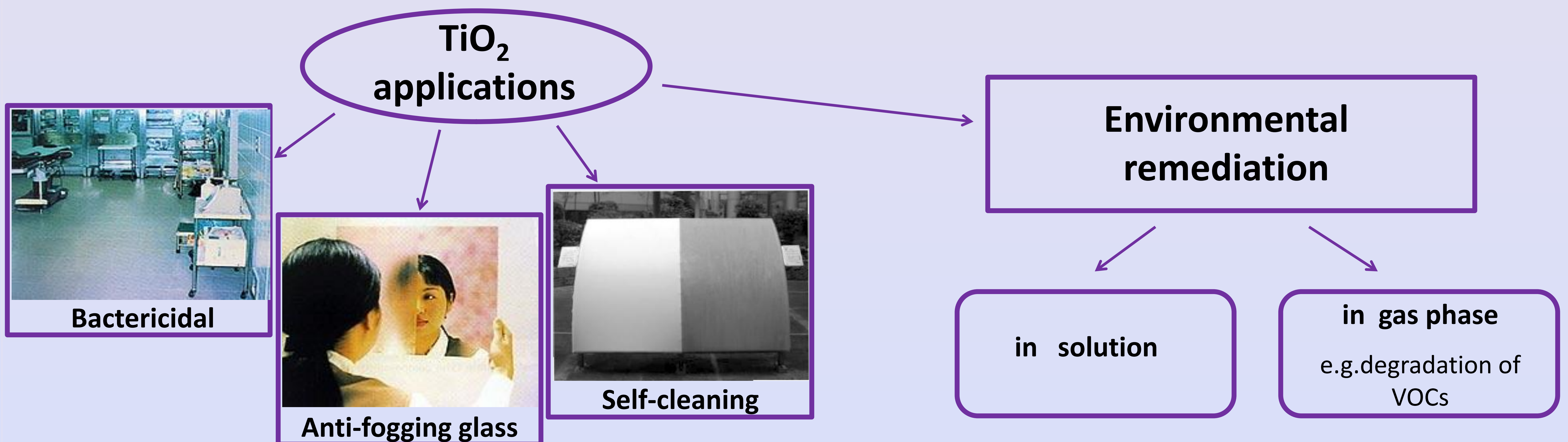
Microstructural and photocatalytic properties of nanocrystalline



TiO₂ prepared by precipitation

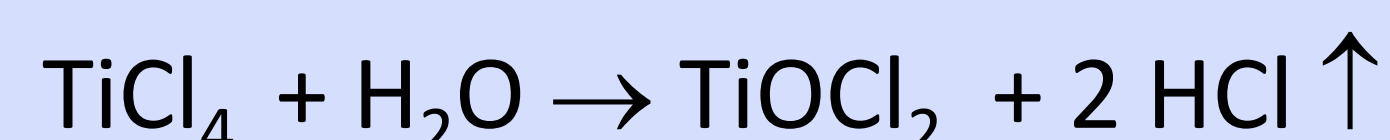
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Materials and method

Crystalline TiO₂ powders were prepared by precipitation from an aqueous TiOCl₂ solution, obtained through reaction between TiCl₄ and water:



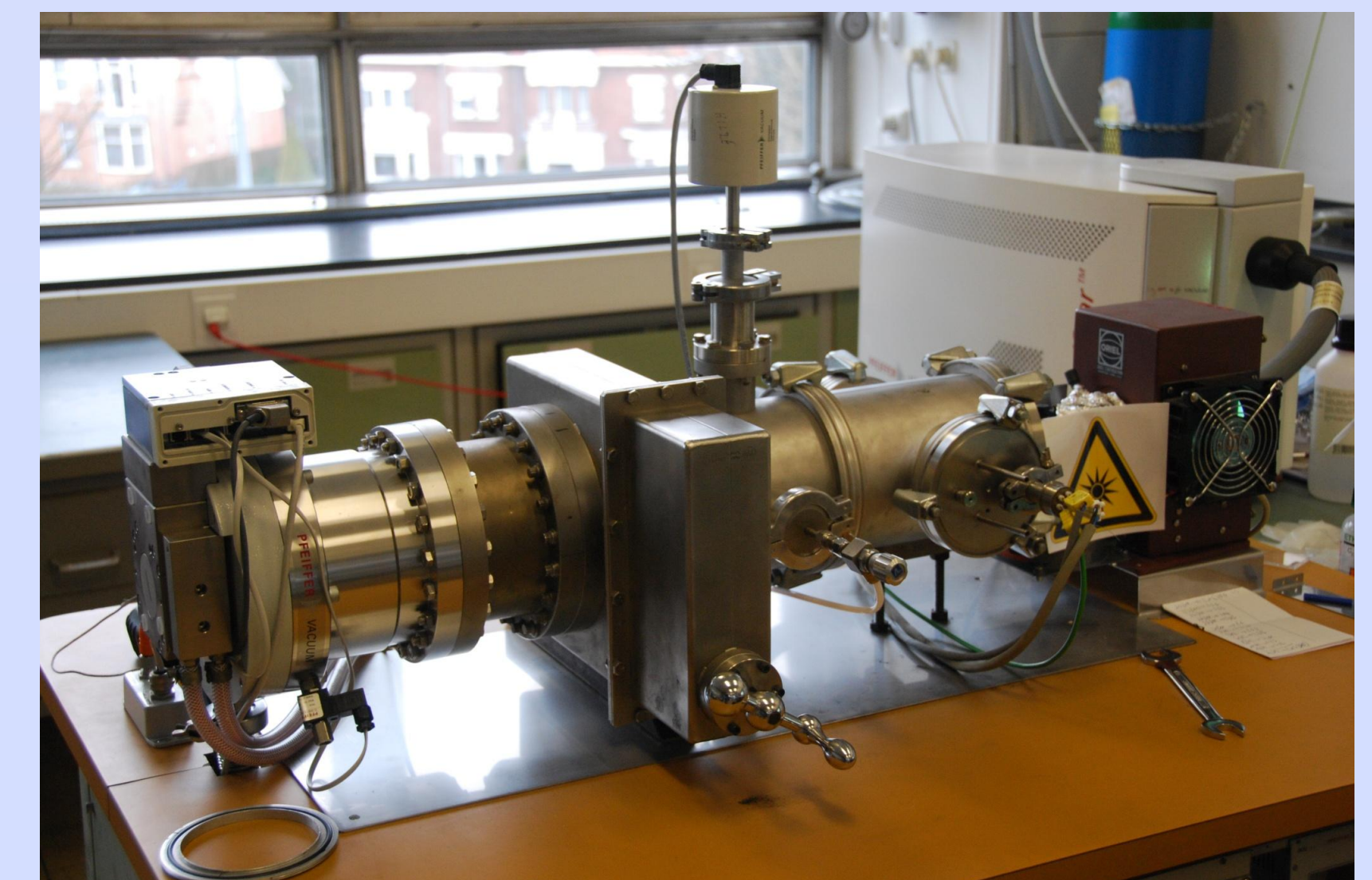
Different amounts of TiOSO₄ were added to enhance the formation of the anatase phase, before the direct hydrolysis to Ti(OH)₄. The films were prepared by spin coating, heat treated at 400 °C in air and compared with that obtained for a sample of P25 Degussa.

The effect of a non-ionic surfactant molecule (Triton X-100) has been evaluated.

Analysis

The films were characterized by X-ray diffraction, scanning electron microscopy, UV-Vis spectroscopy and ellipsometry. The photocatalytic measurements were carried out in a stainless steel batch reactor in a controlled Ar/O₂ atmosphere (ratio 80:20 to simulate air).

The breakdown reaction for EtOH (test substance) was monitored by means of an atmospheric gas analyser containing a mass spectrometer. The light source used was a mercury high-pressure short arc lamp.



Results

Sample	[SO ₄ ²⁻] (mol/l)	Crystallization phase	Photocatalytic activity ± 3σ (ppm/min)
A	0.02	rutile	2.60±0.26
B	0.04	anatase	3.52±0.09
C	0.07	anatase	3.18±0.13
D	0.1	amorphous	0.21±0.07
P25	-	80% anatase-20% rutile	3.44±0.16

A concentration of SO₄²⁻ equal to 0.04 and 0.07 promotes the formation of anatase phase. The porous films obtained from this nanocrystalline TiO₂ show quite good photocatalytic activity for the degradation of EtOH compared to titania films prepared using P25 Degussa. A lower concentration leads to a less active rutile phase whereas a higher one to amorphous phase which hardly shows any activity.

Conclusions

- This cheap and scalable synthesis method yields nanocrystalline TiO₂ particles with a high surface area.
- Tuning the amount of added SO₄²⁻ ions, it is possible to obtain different crystallization phases.
- Triton X-100 addition improves the break-up of the particles agglomeration and it eases the colloid deposition on glass substrate. However, it prevents crystallization of anatase or rutile and therefore its addition leads to very low activity.

Acknowledgements

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